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FISH RESTORATION

Job Performance Report, Project F-73-R-10
Subproject IV: RIVER AND STREAM INVESTIGATIONS
Study V: Wood River Fisheries Investigations
Job 1: Fish Distribution, Abundance, and Movements Job 2: Angler Use, Harvest, and Opinions
Job 3: Evaluation of Angling Regulations
Job 4: Assessment of the Impacts of Irrigation Diversions Job 5: Assessment of the Impacts of Stream Channelization and Snag Removal

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JOB PERFORMANCE REPORT

State of: Idaho Name: RIVER AND STREAM INVESTIGATIONS

Project: F-73-R-10 Title: Wood River Fisheries Investigations

Subproject: IV

Study: V

Period Covered: March 1, 1987 to February 29, 1988

ABSTRACT

In 1986, we began evaluating the status of fish populations in the Big Wood River. Project goals are to (1) determine what factors may be limiting the population and (2) propose management direction. Data from the second year of a multiple-year project is reported herein.

The Big Wood River supports a self-sustaining wild rainbow trout population. Summer densities ranged from 86 to 948 trout/km and averaged 458 trout/km. Wild rainbow trout sampled in summer averaged 211 mm, 15% exceeded 300 mm, and 3.4% exceeded 400 mm.

A substantial sport fishery occurs on the Big Wood River. An estimated 60,806 hours of effort occurred on 74.3 km of stream in 1987. Effort averaged 818 hours/km or approximately 234 angler trips per km. Catch rates (fish harvested + fish released) averaged 1.33 fish per hour and exceeded one fish per hour in all sections censused in 1987. Angler effort and catch increased from 1986 to 1987. Anglers voluntarily released 58% of the catch on censused sections in 1987.

A majority of the anglers we interviewed fished less than 10 days, considered the fishing good or excellent, and were satisfied with the size and abundance of trout. However, a majority also supported more restrictive regulations, regardless of the angling method they used. Most anglers also supported measures to restrict floodplain development.

Habitat types and the presence of cover components affected trout distribution and abundance. Wild rainbow trout were most abundant in pool habitats. Densities of trout increased as the area of cover components increased.

Large concentrations of trout were found in the Baseline Bypass and District irrigation canals. More than 4,200 trout were observed in less than 9 km of canal.

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INTRODUCTION

In 1986, the Idaho Department of Fish and Game initiated an intensive fishery investigation of the Wood River Basin (Figure 1). The project is designed to evaluate the current status of game fish populations and define factors that may be limiting the population. Once limiting factors are defined, recommendations will be made to help restore the population. This report includes data from the second year of a multiple-year project. Data from the initial year and more detailed descriptions of the study area and methods are included in Thurow (1987).

OBJECTIVES

Job No. 1: Fish Distribution, Abundance, and Movements

1. To assess the abundance, distribution, and age structure of fish stocks in the Big Wood River and principal tributaries.
2. To characterize movement patterns of the spawning and rearing phases of rainbow and brown trout in the Big Wood River.

Job No. 2: Angler Use, Harvest, and Opinions

1. To estimate angler effort and harvest on selected areas of the Big Wood River.
2. To survey angler opinions and preferences on selected areas of the Big Wood River.

Job No. 3: Evaluation of Angling Regulations

1. To compare fish populations in general regulation sections of similar habitat with fish populations within the following special regulation sections: Big Wood River - Hulen Meadows to North Fork Bridge; Little Wood River - "Bear Tracks" Williams State Recreation Area.
2. To compare angler effort, catch, and angler opinions within special regulation and general regulation stream sections.
3. To evaluate movements of fish stocks between special regulation and general regulation stream sections.

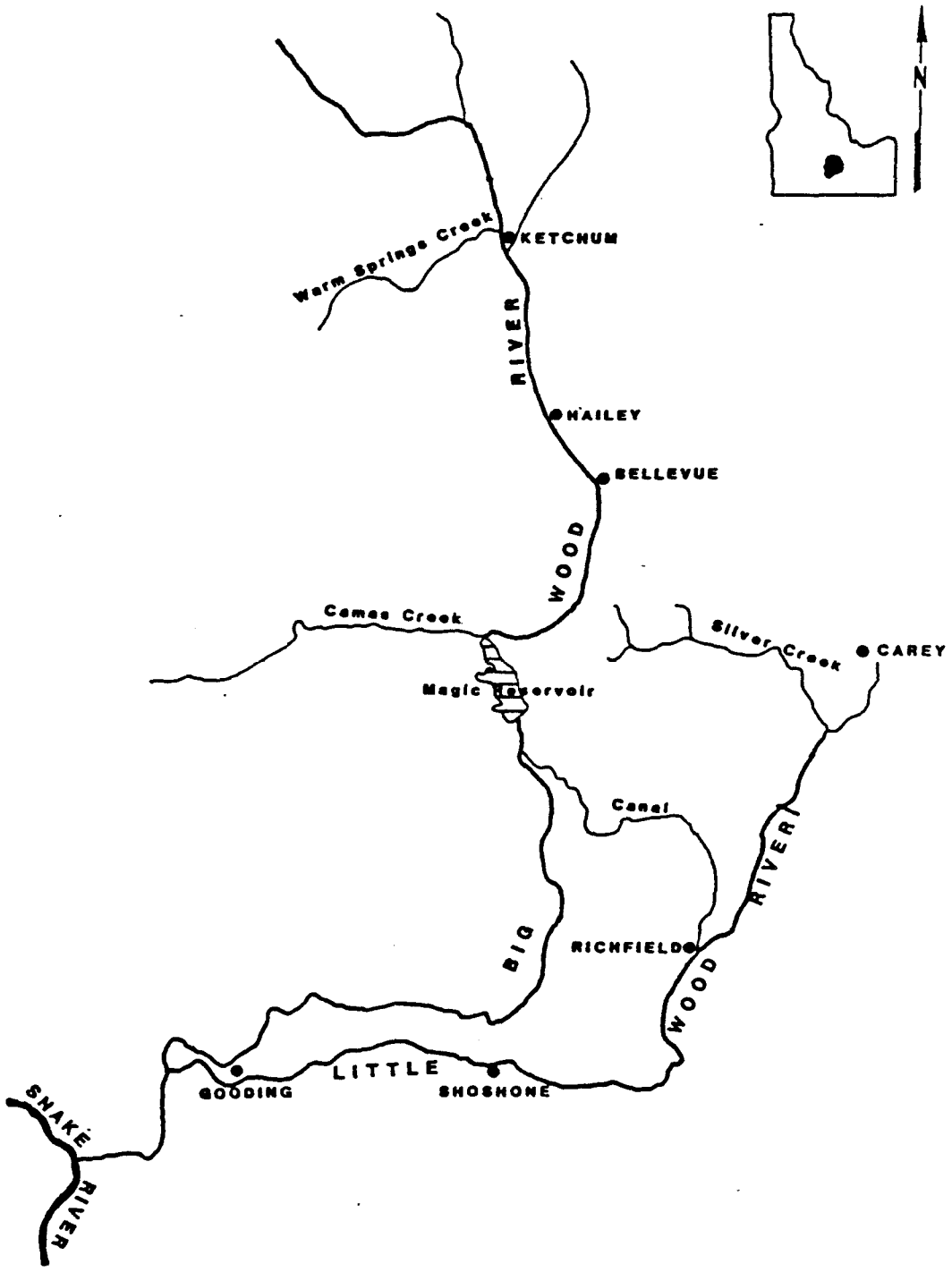

Figure 1. Wood River drainage, Idaho.

Job No.-4: _ Assessment of the Impacts of Irrigation Diversions

1. To assess the impact of unscreened irrigation diversions on fish populations in the Big Wood River.

2. To evaluate the feasibility of screening diversions if they adversely impact fish populations.

Job No. 5: Assessment of the Impacts of Stream Channelization and Snag Removal

1. To compare fish populations in channelized and unchannelized stream sections of the Big Wood River and tributaries.

2. To assess the value of logs and woody debris as fish habitats in the Big Wood River and tributaries.

3. To assist in development of criteria for protection of fish habitat during stream channelization and snag-removal projects in the Big Wood River and tributaries.

RECOMMENDATIONS

1. More than 45 km of canal in the Baseline Bypass and District Canal complexes have not been surveyed. Additional subsampling of these canals should be conducted to document the magnitude of fish losses.

2. If permission is granted by the irrigation district, select one or more diversions to evaluate the potential benefits of a staged flow reduction in reducing fish losses. A control diversion should also be tested.

3. The 1922 Baseline Bypass Decree warrants further investigation. It may be necessary to request that a flow analysis be performed to test the basis for the Decree.

4. If permission is granted, test the benefit of a staged flow reduction when water is diverted down the Baseline Bypass Canal.

5. Alternatives should be explored to provide passage for upstream migrating rainbow trout through the Glendale diversion. If flows cannot be secured, the Baseline Bypass Canal should be surveyed to evaluate the feasibility of installing fish passage devices.

6. Alternatives to the use of streambed gravel for diversion dikes should be explored.

7. The Demonstration Project north of Ketchum provides an opportunity to evaluate different. measures to restore channel stability and fish habitat. Successful approaches may have widespread application to other reaches of the Big Wood River and other Idaho rivers. A long-term evaluation should be established.

METHODS

Trout Populations

During 1987, mark-recapture electrofishing surveys were completed in the identical reaches surveyed in 1986 using the techniques described by Thurow (1987).

Movements

Following procedures initiated in 1986, we differentially fin-clipped trout in each reach. Trout larger than 250 mm were tagged with Floy tags. Recapture data was obtained via subsequent electrofishing surveys and from angler returns.

A brown trout spawn taking operation was initiated on the Big Wood River in 1987. Hayspur Hatchery personnel installed a weir approximately 0.5 km upstream from the Sheep Bridge on October 1 (Thorpe 1988). All mature brown trout were measured, Floy tagged, and sexed. A portion of the fish were spawned and the remainder were released upstream to spawn naturally.

To describe brown trout spawning movements in 1987, we duplicated the brown trout redd survey conducted in 1986. On November 17, we walked the Big Wood River between the Sheep Bridge and the Baseline Bypass confluence with the Big Wood River. We counted all visible trout redds. We counted all side channels.

Due to low stream discharge, the river was not inundated by Magic Reservoir above the confluence of Rock Creek. Consequently, we also walked and surveyed the river between Rock Creek and the Sheep Bridge. Redd count data is summarized in the Movements sections of the RESULTS.

To evaluate movements of hatchery-reared rainbow trout, Hayspur Hatchery personnel jaw tagged 200 catchable trout. Lots of 100 trout each were released at the Sunpeak Park and North Fork Campground, respectively, on August 23. We acquired recapture information by electrofishing surveys and from voluntary returns by anglers.

Creel Census

Stream segments selected in 1986 were incorporated into the 1987 angler census. We censused four sections (1, 2, 5, and 9) not surveyed in 1986 and recensused three sections (4, 7, 11) as an index for comparison.

A stratified angler-count census was applied to estimate angler effort and harvest. The census was stratified by 14-day intervals and day type (weekday, weekend, and holiday). The 1987 census included twelve 14-day intervals and one 7-day interval. During each interval, we randomly selected two weekdays, two weekend days, and included all holidays for counts. Three counts were made each day with counts adjusted by daylight hours. Counts in 1987 were conducted identically to those in 1986. During the count periods, a clerk surveyed the river within each section and recorded the total number of anglers observed. Within sections 1, 5, and 9, dense riparian areas restricted our ability to observe all anglers. To compensate, we recorded vehicle counts when no anglers could be found and applied a correction factor of 1.8 anglers per vehicle (based on a sample of 692 vehicles in 1987) to estimate total anglers.

Harvest and release rates were obtained by interviewing anglers throughout each interval. We also collected data on size and species of fish in the catch, angling methods, and angler residence. Angler opinions on present management programs and their preferences for future management were also noted.

We applied a stratified angler-count census to estimate effort and harvest during the winter. The census was stratified by month (January, February, March), and we randomly selected four weekend days per month. Weekday counts were made as often as feasible. Because of limited manpower, weekday counts were made in isolated stream sections only. We estimated the ratio of the effort during weekends and weekdays and expanded the effort estimates by this ratio where weekday counts were not made. Effort and harvest calculations were made following the procedure described by Thurow (1987).

Evaluation of Special Regulations

Using procedures outlined by Thurow (1987), we compared fish population and creel census data for stream reaches managed by catch-and-release regulations with reaches managed by general regulations.

Trout Habitat Relationships

We compared established habitat criteria and trout densities to evaluate the importance of various habitat types and cover components to fish populations. In addition, we collected preproject baseline data within the Demonstration Project area.

Snorkel Surveys

Habitat types were systematically selected within reaches 2, 3, and 4 while proceeding upstream. At each site, we classified the habitat type (pool, riffle, glide, etc.) using the definitions proposed by Bisson et al. (1982). We measured the surface area of the habitat and measured the length and average width of cover components. The areas of each cover component were summed for each habitat and expressed as a percentage of the total. Using a mask and snorkel, we counted the total number of salmonids by 100 mm size groups at each site.

Demonstration Project Baseline Data

A joint, multiagency agreement will implement a demonstration project in the Big Wood River above Ketchum (Anonymous 1987a). The project will test the effectiveness of drop structures, vegetative management, and addition of instream structure in restoring channel stability and fish habitat. In 1987, we collected preproject baseline data in the Phase I area between the Hulen Meadows and Lake Creek bridges.

A mark-recapture electrofishing survey was completed in the entire reach. We used an aluminum canoe as the cathode and waded upstream with two mobile anodes. All captured trout were measured (total length) by species, weighed, and given a temporary fin clip. The modified Petersen mark-and-recapture estimator was used to estimate the population of trout (>100 mm) in the reach (Ricker 1975).

Habitat types and cover components were mapped in the reach from Hulen Meadows Bridge to the Lake Creek Bridge. Using a range finder and tape, we established transects at 100 m intervals proceeding upstream. At each transect, we collected the following data: channel width, maximum depth, streambank stability rating (stable, cutting, depositioned, or riprapped) streambank vegetative stability (Platts et al. 1983), and substrate components. Simultaneously, we identified different habitat types (riffles, pools, glides, etc.). The length and average width of each habitat were measured to enable surface area estimation. The lengths and areas of each habitat type were summed for each reach and expressed as a percentage of the total. Proceeding downstream, we recorded cover components (woody debris, undercuts, vegetative overhang, partially exposed boulders, etc.). The length and average width of each cover component were measured to estimate area. The lengths and areas of each cover component were also summed for each reach and expressed as a percentage of the total.

We also collected data for future instream flow evaluation as a means of assessing habitat changes caused by the stream stabilization work in the Hulen Meadows reach. A total of six cross sectional transects were established, and water surface elevations were surveyed for later computer modeling. Measurements included at each transect were water depth, velocity, and substrate type (numeric rating). At least 20 cells were measured for each transect. Hydraulic information will be used in instream flow incremental methodology (IFIM) models to simulate stream conditions at varying discharges.

Information generated from this IFIM study will be compared to similar information collected after stream rehabilitation work is completed. Phase I of the rehabilitation was completed in November 1987.

Irrigation Diversions

Project personnel walked and visually surveyed 20.4 km of seven irrigation canals on the Big Wood River between August 17 and September 10. Visibility was suitable for a complete count of trout in all canals except the Hiawatha canal. Trout were recorded by 100 mm groups.

Snorkel surveys were completed in sections of the Baseline Bypass and District canals. These canals were too large to conduct reliable ground counts. Two snorkelers floated simultaneously downstream. Snorkeler #1 counted all fish to his right, and snorkeler #2 counted all fish to his left. We surveyed 6.7 km of the Baseline Bypass and 2 km of the District Canal And recorded trout by 100 mm groups.

RESULTS

Trout Populations

Species Composition

Wild rainbow trout comprised a majority of the salmonids captured in the Big Wood River in 1987 (Table 1). The abundance of hatchery-reared rainbow trout in reaches 5 and 6 was a result of 1987 introductions. Hatchery trout were intentionally stocked in Reach 5 and they strayed upstream into Reach 6 from the Hulen Meadows Bridge. Hatchery trout will not be introduced at the Hulen Meadows Bridge in the future. During spring 1987 surveys, we captured 23 hatchery trout which were holdovers from 1986 introductions.

Mountain whitefish Prosopium williamsoni were abundant in reaches 2 through 7, but were not enumerated. Brook, brown, and cutthroat trout were present in small numbers and were not found in all reaches (Table 1).

Abundance

We completed mark-recapture population estimates in seven reaches of the Big Wood River (Appendix A). Spring estimates did not provide reliable estimates of abundance due to elevated stream discharge, turbid water conditions, and movements of spring-spawning rainbow trout.

Population estimates varied considerably among reaches and with season (Table 2). Summer densities of wild rainbow trout ranged from 86 to 948 trout/km in 1987 and from 156 to 1,068. trout/km in 1986 (Thurow 1987). Summer densities fluctuated in reaches 3 and 4 from 1986 to 1987 and remained similar in remaining reaches (Figure 2).

Table 1. Species composition and numbers of salmonids captured by electrofishing in the Big Wood River, 1987.

Reach	Season	Wild rainbow trout	Hatchery rainbow trout	Brook trout	Brown trout	Cutthroat trout	Total	% wild rainbow trout
1	Spring	99	2	0	1	0	102	97
2	Spring	109	5	3	0	0	117	93
	Summer	254	20	8	0	0	282	90
	Fall	233	11	2	0	0	246	95
	Total	596	36	13	0	0	645	
3	Spring	78	3	1	0	0	82	95
	Summer	204	2	1	0	1	208	98
	Fall	252	0	0	1	0	253	100
	Total	534	5	2	1	1	543	
4	Spring	63	1	0	0	0	64	98
	Summer	332	11	3	0	0	346	96
	Fall	172	3	1	0	0	176	98
	Total	567	15	4	0	0	586	
5	Summer	165	169	9	0	0	343	48
6	Spring	22	9	3	0	0	34	65
	Summer	144	233	15	0	0	392	37
	Fall	131	110	4	0	0	245	53
	Total	297	352	22	0	0	671	
7	Spring	1	0	0	0	0	1	100
	Summer	78	3	13	0	0	94	83
Grand total		2,337 (78%)	582 (19%)	63 (2%)	2	1	2,985	

Table 2. Estimated trout populations (fish >100 mm) and densities in electrofished reaches of the Big Wood River, 1987.

		All trout			Wild rainbow trout		
Reach	Season	Population estimate	95% confidence interval	Density #/km	Population estimate	95% confidence interval	Density #/km
1	Spring	630	(327-8,405)	341	611	(317-8,153)	330
2	Spring	1,378	(699-46,467)	689	1,282	(650-43,214)	641
	Summer	1,680	(1,121-3,345)	840	1,512	(1,008-3,010)	756
	Fall	3,627	(1,977-21,863)	1,814	3,446	(1,878-20,769)	1,722
3	Spring	----------	----------	No recaptures	----------	----------	-
	Summer	636	(458-1,039)	596	623	(449-1,018)	584
	Fall	728	(500-1,334)	682	728	(500-1,334)	682
4	Spring	----------	----------	No recaptures	----------	----------	-
	Summer	1,954	(1,359-3,478)	987	1,876	(1,304-3,339)	948
	Fall	400	(298-606)	202	384	(292-594)	194
5	Summer	647	(526-841)	547	311	(252-404)	262
6	Summer	830	(684-1,055)	722	307	(253-390)	267
	Fall	422	(350-533)	367	224	(186-282)	195
7	Summer	112	(88-156)	104	93	(73-129)	86

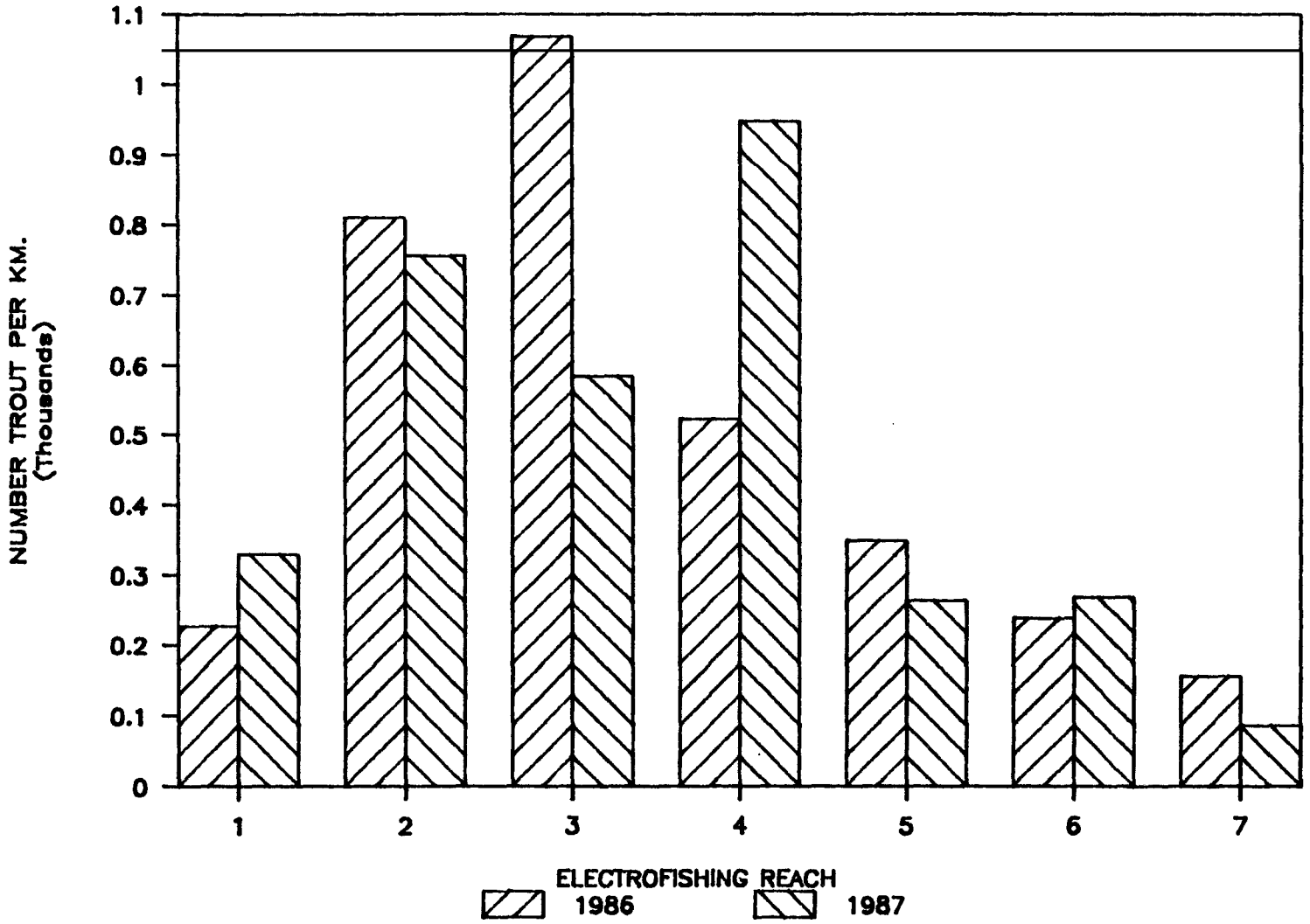

Figure 2. Summer densities of wild rainbow trout in the Big Wood River, 1986 and 1987.

Sizes

Wild rainbow trout captured by electrofishing ranged from 50 to 510 mm (Figure 3). Sizes of trout varied among reaches and by season. We captured more large (>300 mm) trout and fewer juvenile (<200 mm) trout during spring surveys than summer or fall surveys (Table 3). During summer surveys, the proportion of trout larger than 300 and 400 mm ranged from 3 to 27% and from 0 to 8%, respectively. The mean total length and proportion of trout larger than 300 mm remained similar or increased between summer and fall in most reaches.

Reaches 2, 3, and 4 supported the largest summer proportion of trout exceeding 300 and 400 mm (Table 3). Reaches 6 and 7 supported the largest proportion of juvenile (<200 mm) trout.

Movements

A total of 558 trout were Floy tagged during spring, summer, and fall electrofishing surveys in 1987. An additional 99 brown trout were Floy tagged at the weir on the Big Wood River during fall 1987 spawn taking operations. Approximately 1,542 trout have been Floy tagged since the project was initiated in 1986.

During 1987, we recovered tag data during electrofishing surveys and through voluntary returns by anglers. We recaptured 257 Floy-tagged trout during seasonal electrofishing surveys and recorded locations, lengths, and weights. Anglers returned information on 74 additional tagged trout between May 23, 1987 and March 1, 1988.

Final analysis of tag recovery data will await the completion of field surveys in 1988. Tag recovery data will be analyzed to document typical movement patterns of the spawning and rearing phases of wild rainbow trout. Data will be evaluated to determine if interchange of fish occurs between reaches. In addition, successive recaptures within a reach will be tabulated to determine if a mortality estimate can be made. Finally, recapture data will be used to verify growth information by measuring changes in length and weight.

Brown Trout

Mature brown trout migrated from Magic Reservoir in the fall to spawn in a 11.3 km reach of the Big Wood River. The initial brown trout were captured at the weir on October 4 (Thorpe 1988). Initial spawning activity (redd construction) was observed after October 10. Between October 4 and November 10, 99 mature brown trout entered the weir. Trout ranged from 280 to 720 mm and included 68 females and 31 males.

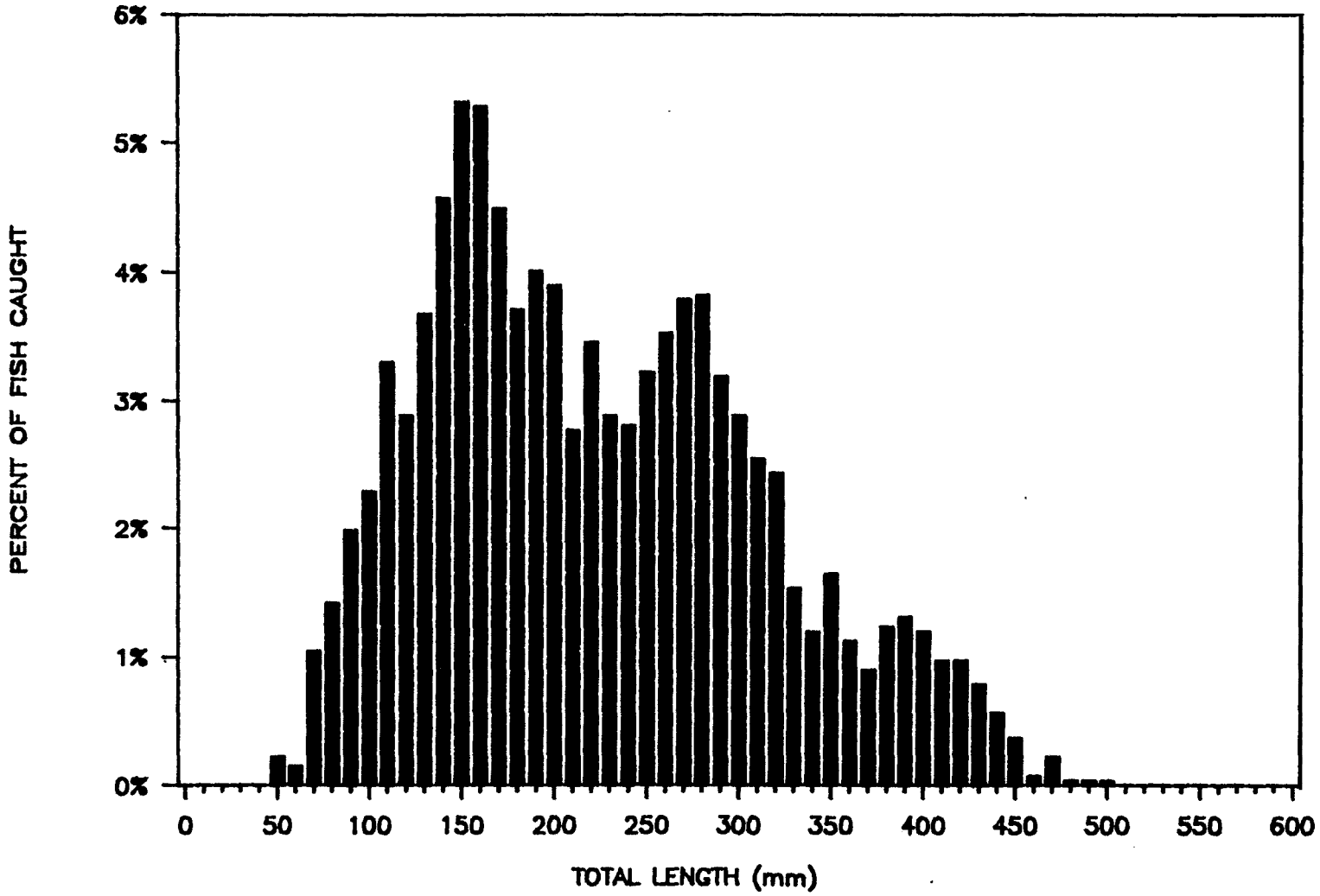

Figure 3. Length frequencies of wild rainbow trout captured by electrofishing in reaches 2 to 7, Big Wood River, 1987.

Table 3. Length statistics for wild rainbow trout in the Big Wood River, 1987.

Reach	Season	N	Mean total length (mm)	Standard deviation	<200 mm #	<200 mm (%)	>300 mm #	>300 mm (%)	>400 mm #	>400 mm (%)
1	Spring	99	249	140	46	(46)	45	(45)	21	(21)
2	Spring	109	259	113	43	(30)	44	(40)	15	(14)
	Summer	254	222	92	116	(46)	48	(q9)	12	(5)
	Fall	233	240	81	75	(33)	45	(19)	8	(3)
	Total	596	236	93	237	(40)	137	(23)	35	(6)
3	Spring	78	279	115	22	(28)	36	(46)	15	(19)
	Summer	204	217	105	102	(50)	44	(22)	17	(8)
	Fall	252	185	93	167	(66)	37	(15)	3	(1)
	Total	534	211	106	291	(54)	117	(22)	35	(7)
4	Spring	63	293	98	14	(22)	33	(52)	10	(16)
	Summer	332	251	161	114	(35)	87	(27)	14	(4)
	Fall	172	262	87	46	(27)	70	(41)	5	(3)
	Total	567	259	137	174	(31)	190	(34)	29	(5)
5	Summer	165	179	65	107	(65)	5	(3)	1	(1)
6	Spring	22	209	99	13	(59)	5	(23)		
	Summer	463	192	71	292	(63)	37	(8)	7	(2)
	Fall	240	209	76	119	(50)	26	(11)	4	(2)
	Total	725	198	74	424	(58)	68	(9)	11	(2)
7	Spring	1	186	0	1	(1)	0	(0)	0	(0)
	Summer	78	172	60	55	(71)	2	(3)	0	(0)
	Total	79	172	60	56	(71)	2	(3)	0	(0)
2-7	Spring	273	268	111	93	(34)	118	(43)	40	(15)
	Summer	1,496	211	107	786	(53)	223	(15)	51	(3)
	Fall	897	220	89	410	(46)	178	(20)	20	(2)
	Total	2,666	220	103	1,289	(48)	519	(19)	111	(4)

The brown trout which entered the weir comprised only a portion of the population which spawned in the Big Wood River. We completed redd counts on November 19 and observed 104 redds downstream from the weir to the confluence with Rock Creek. An additional 92 redds were observed upstream from the weir. Only 30 redds were observed upstream from the Stanton Crossing Bridge.

Hatchery Rainbow Trout

We recaptured 30 of 200 jaw-tagged hatchery trout. Anglers recaptured 10 trout which were originally released at the Sun Peak Park. We electrofished seven tagged trout and anglers recaptured thirteen additional trout which were originally released at the North Fork Campground. All of the trout were recaptured between August 24 and November 9. Most (90%) were recaptured within 21 days of release (August 23).

Hatchery trout exhibited downstream movements from the stocking location. We recaptured ten trout which moved more than 1 km from the stocking location. Ninety percent moved downstream. One trout migrated more than 11 km downstream between August 23 and October 12. One recaptured trout moved upstream more than 1 km. The remainder of the trout were recaptured within 1 km of the stocking site.

This preliminary data on movements was applied to reduce movements of hatchery trout into the catch-and-release (C&R) area. Hatchery trout were formerly introduced at the North Fork Campground approximately 1 km upstream from the C&R boundary. In 1988, hatchery trout will be introduced at the Wood River Campground approximately 3.5 km upstream from the C&R boundary.

Creel Census

Angler Effort

Anglers fished an estimated 25,753 hours on censused sections of the mainstem Big Wood River between May 23 and November 13, 1987 (Appendix B). Approximately 36.8 km of stream were censused. Excluding Section 2 (dewatered on July 16), effort averaged 824 hours per km of stream censused, which equates to 235 angler trips (at 3.5 hours per trip) per km. Total effort peaked in August (Figure 4).

An increase in angler effort occurred between 1986 and 1987. Within sections 4, 7, and 11, effort increased by 102%, 54%, and 62%, respectively, from 1986 to 1987 (Figure 5). The Big Wood River sustained more angler effort between the opening weekend and June 13 in 1987 than in 1986. Effort increased by a mean of 68% from 1986 to 1987.

We estimated by expansion that 60,806 hours of effort occurred on the entire 74.3 km of stream between Magic Reservoir and Easley Hot Springs (Appendix C). The expansion excluded the mainstem Big Wood River above Easley Hot Springs and all tributaries and therefore represents only a portion of the total effort above Magic Reservoir.

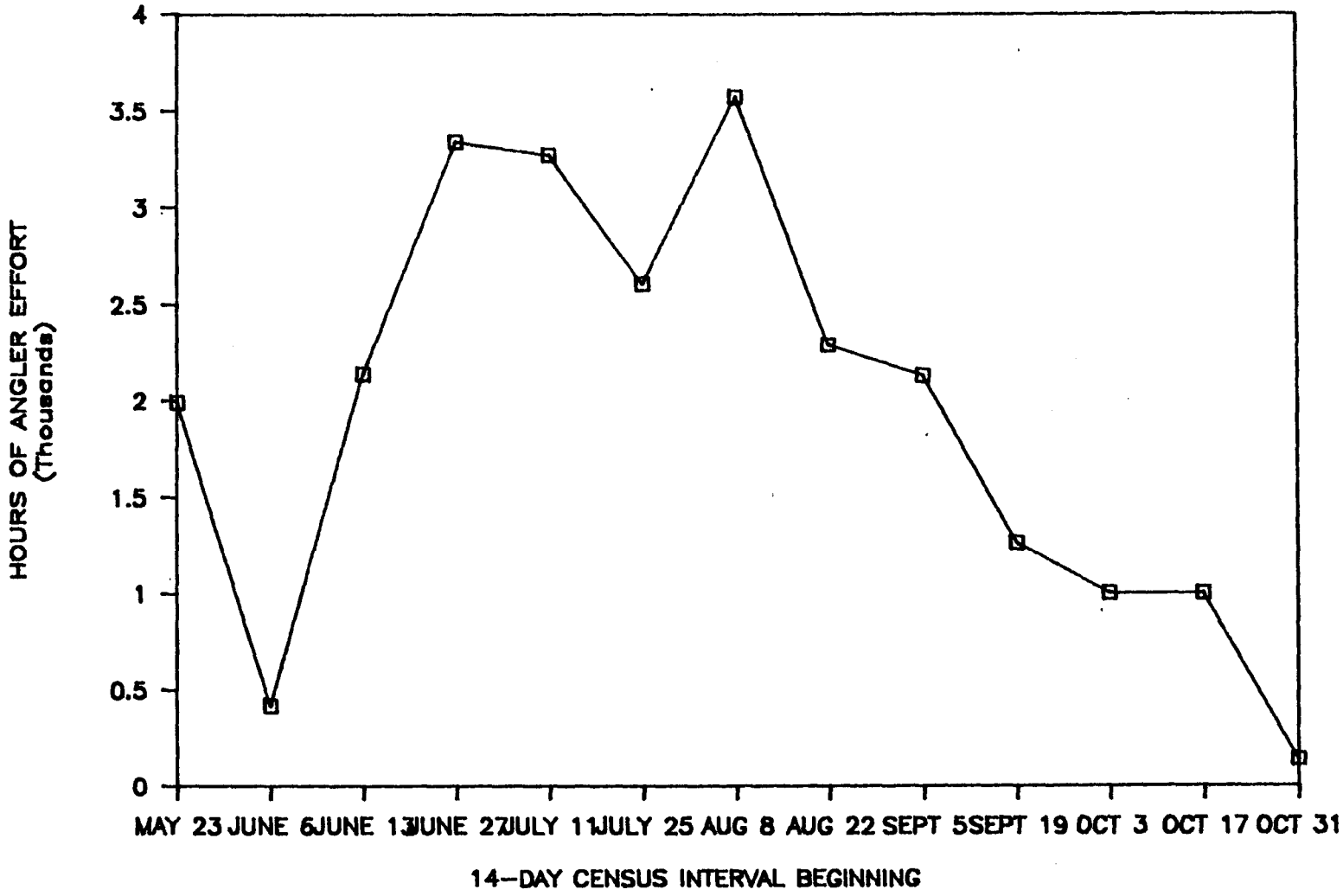

Figure 4. Distribution of angler effort on censused sections of the Big Wood River, 1987.

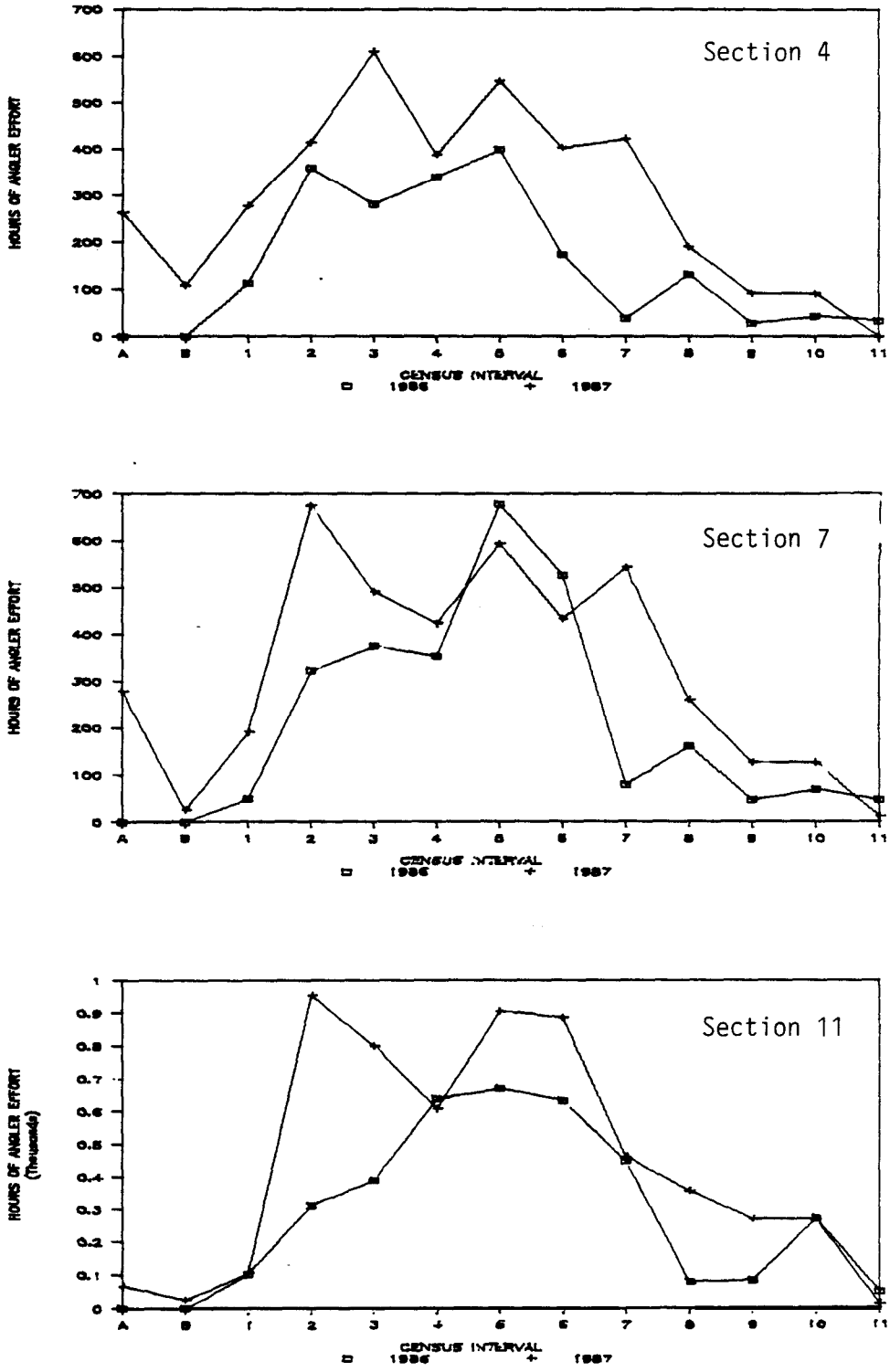

Figure 5. Distribution of angler effort on sections 4, 7, and 11 of the the Big Wood River, 1986 and 1987.

Catch

In 1987, catch rates (fish harvested and released per hour) for all trout species combined averaged 1.33 fish per hour and exceeded one fish per hour in all censused sections (Appendix D). Catch rates peaked during intervals 2 (June 27 to July 10) and 6 (August 22 to September 4). In 1987, peak catch rates closely followed the emergence of two major aquatic insects, Ephemerella dotsi during Interval 2 and Ephemerella hecuba during Interval 6. Catch rates exceeded one fish per hour in nine of eleven sections censused in 1986 and 1987 (Figure 6).

Anglers caught an estimated 34,113 trout from 31.1 km of stream censused in 1987 (Table 4). During 1986 and 1987 combined, anglers caught a total of 51,009 trout from 68.6 km of stream for an average of 744 trout per km (Appendix E). The catch per km increased in sections 4, 7, and 11 from 1986 to 1987.

A substantial proportion of the total catch was released. In 1987, anglers released 79% of the catch within censused reaches (Table 5). During 1986 and 1987 combined, anglers released 662 of the catch (Appendix E). Anglers within the general regulation areas (excluding Section 11) released 582 of the catch. Within sections 5, 6, 7, and 9, anglers voluntarily released more than 70% of the catch.

Many trout were apparently caught and released several times during the season. Summer densities of trout averaged 987 fish per km in an electrofishing reach (#4) within Section 7 (Table 2). Since anglers caught an estimated 2,391 trout per km, the average trout was caught 2.4 times (Appendix E). Within Section 11, anglers caught an estimated 1,261 trout per km and densities (Reach #6) averaged 722 trout per km. Consequently, we estimated that each trout was caught an average of 1.8 times.

Anglers harvested approximately 7,198 trout from 31.1 km of stream censused in 1987 (Table 4). During 1986 and 1987 combined, anglers harvested a total of 17,099 trout from 60.3 km of stream (Section 11 excluded) (Appendix E).

The temporal distribution of the harvest varied between 1986 and 1987. In 1986, harvest was minimal prior to Interval 4 and most harvest occurred during intervals 4, 5, and 6 (692 of the harvest) (Figure 7). In 1987, most harvest occurred during intervals 2 to 5 (51% of the harvest). During both years, a majority of the harvest occurred prior to Interval 7 (beginning September 5).

Hatchery-reared rainbow trout comprised a majority (52%) of the harvest from all sections combined in 1986 and 1987 (Appendix E). Wild rainbow trout (44% of total) were the predominant species harvested in the remaining sections. Brown trout were harvested within Section 1 only and comprised 3% of the total harvest, followed by brook trout which comprised 1%.

Hayspur Hatchery personnel estimated that 19,900 hatchery-reared rainbow trout were stocked in the censused sections in 1986 and 1987 (Table 6). Anglers harvested approximately 48% of the trout stocked. Returns to the creel ranged from 30% to 79%.

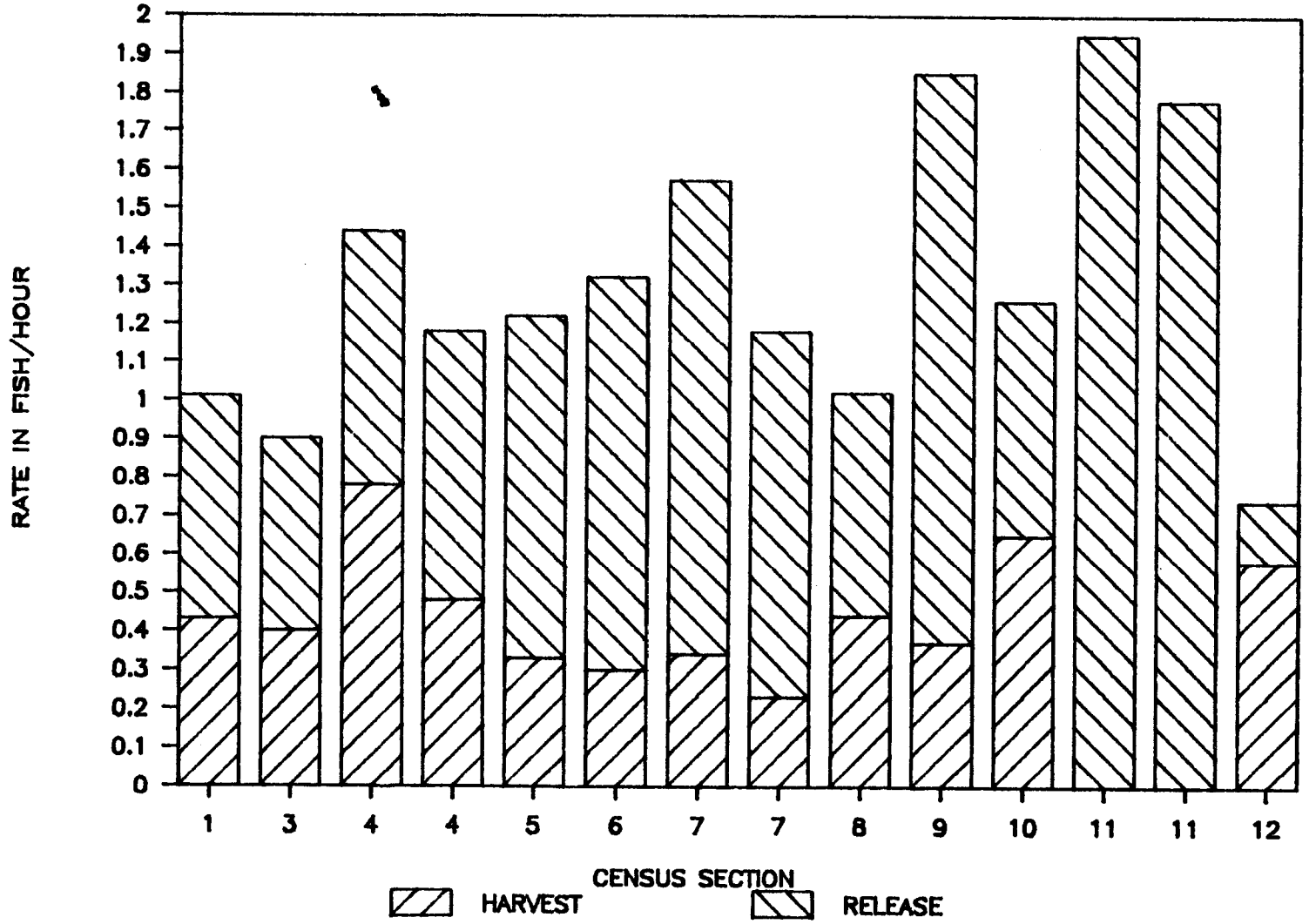

Figure 6. Catch rates by section, Big Wood River, 1986 and 1987.

Table 4. Estimated harvest and catch (fish harvested and.fish released) of trout from sections of the Big Wood River, 1987. The +95% confidence intervals are shown in parentheses.

Section	Harvest: Hatchery rainbow trout	Harvest: Brook trout	Harvest: Wild rainbow trout	Harvest: Total	Total catch	Catch per km
1	258 (112)	80 (34)	1,151 (500)	1,985[a] (862)	4,662 (1,785)	444
4	568 (450)	38 (31)	1,287 (1,020)	1,893	4,653 (2,873)	1,454
5	395 (366)	36 (33)	1,366 (1,265)	1,797	6,590 (3,889)	1,433
7	127 (39)	0 (0)	852 (258)	979 (297)	5,022 (2,074)	2,391
9	332 (562)	22 (37)	190 (322)	544 (921)	2,718 (3,263)	1,132
11	---------- Catch-and-release ----------				10,46 (4,786)	1,261
Total	1,680 (1,529)	176 (135)	4,846 (3,365)	7,198 (5,245	34,11 (18,670) 3	
Percent	232	3%	67%	79% of catch released		

[a]lncludes 496 (216) brown trout, 7% of total.

Table 5. Catch and harvest rates (fish/hour) and the percentage of trout released by anglers using various terminal tackle, Big Wood River, 1987.

Section	Harvest				Catch rate				Percent trout released			
	Bait	Lure	Fly	Multiple	Bait	Lure	Fly	Multiple	Bait	Lure	Fly	Multiple
1	0.58	0.14	0.10	0.39	0.94	0.56	1.10	1.59	38	75	91	75
4	0.73	0.59	0.06	0.68	0.87	2.10	1.34	1.25	16	72	96	46
5	0.94	0.52	0.12	0.41	1.02	1.74	1.24	0.96	8	70	90	57
7	0.38	0.47	0.18	0.00	0.68	2.23	1.37	0.11	44	79	87	100
11	- - - - - Catch-and-release ----------						1.77	--	--	100	100	--
Total[a]	0.61	0.39	0.14	0.49	0.91	1.43	1.34	1.24	33%	73%	90%	63%

[a]Excluding Section 11.

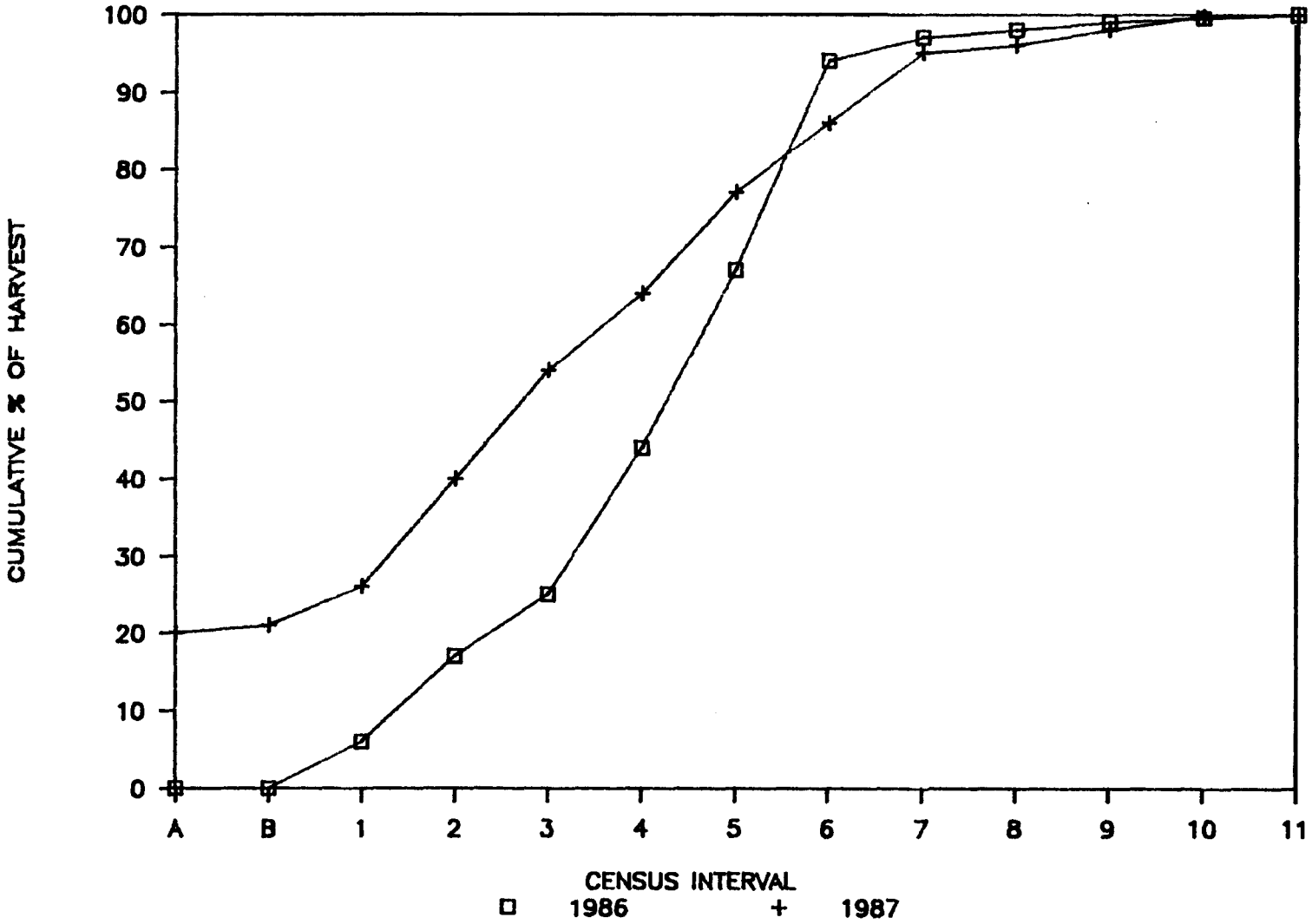

Figure 7. Cumulative percent of the harvest by census interval, 1986 and 1987.

Table 6. Estimated return-to-the-creel of hatchery rainbow trout stocked in sections of the Big Wood River, 1986 and 1987.

Section	Estimated hatchery trout stocked		Estimated harvest		Percent return-to-the-creel
	No.	No. per km	No.	No. per km	
1986					
3	2,000	217	1,030	112	52%
4	1,400	438	671	210	48%
6	800	118	565	83	71%
7	600	286	235	112	391
8	2,000	435	1,443	314	721
10	3,000	811	1,789	484	60%
12	8,000	60	2,366	179	30%
Total	17,800	416	8,099	189	*46%*
1987					
4	900	281	568	178	631
5	500	109	395	86	79%
7	200	95	127	61	641
9	500	208	332	138	661
Total	2,100	171	1,422	116	68%
Grand total	19,900	361	9,521	173	48%

Harvested wild rainbow trout ranged from 160 to 490 mm and averaged 316 mm (Figure 8). As we observed in 1986, anglers released trout less than 250 mm and selected larger trout. A majority of the harvest was comprised of two- and three-year-old trout ranging from 170 to 360 mm.

Angler Attributes

Residents comprised a majority of the anglers we interviewed on the Big Wood River in 1986 and 1987. Excluding Section 11, resident anglers comprised 67% of the anglers interviewed (Table 7). Nonresident anglers comprised a majority (mean of 66%) in Section 11 during both 1986 and 1987.

All anglers either waded or fished from the bank. Anglers using bait comprised 46% of the anglers (excluding Section 11) (Table 7). Bait anglers comprised more than 50% of the anglers in sections 1, 3, 8, 10, and 12. With the exception of Section 1, the remaining four sections received the largest stockings of catchable rainbow trout. Anglers using flies, lures, or multiple tackle comprised a majority of the anglers in the remaining sections. Anglers using flies were most predominant in sections 5, 6, 7, and 9. Anglers in Section 11 were required to use flies or lures and few used lures.

Anglers using flies and lures enjoyed the largest catch rates (Table 5). Fly anglers released a majority (90%) of their catch voluntarily. Anglers using bait experienced the poorest catch rates and they released the smallest percent (33%) of their catch.

Angler Opinions

A majority of the anglers we interviewed on the mainstem Big Wood River fished less than 10 days, considered the fishing good or excellent, and were satisfied with the current size and abundance of trout (Appendix F). However, a majority would support more restrictive regulations if those regulations increased the size and abundance of trout. The majority (92%) of anglers supported more restrictive regulations regardless of the method they used (Appendix F).

Anglers on all sections were also supportive of the stocking of hatchery rainbow trout in "some sections" of the Big Wood River regardless of the method they used (Appendix F).

Many anglers in Section 7 (47%) believed more public access is needed. Section 7 (Box Car Hole to Red Top Meadows) is bordered by a private development and access is restricted. Most anglers within the other censused stream sections did not believe more access is needed (Appendix F).

A majority of the anglers favored measures to prevent further floodplain development and stream alterations (Appendix F). Most also supported a consumptive winter trout fishery. Anglers in Section 1 were supportive of the increasing brown trout population.

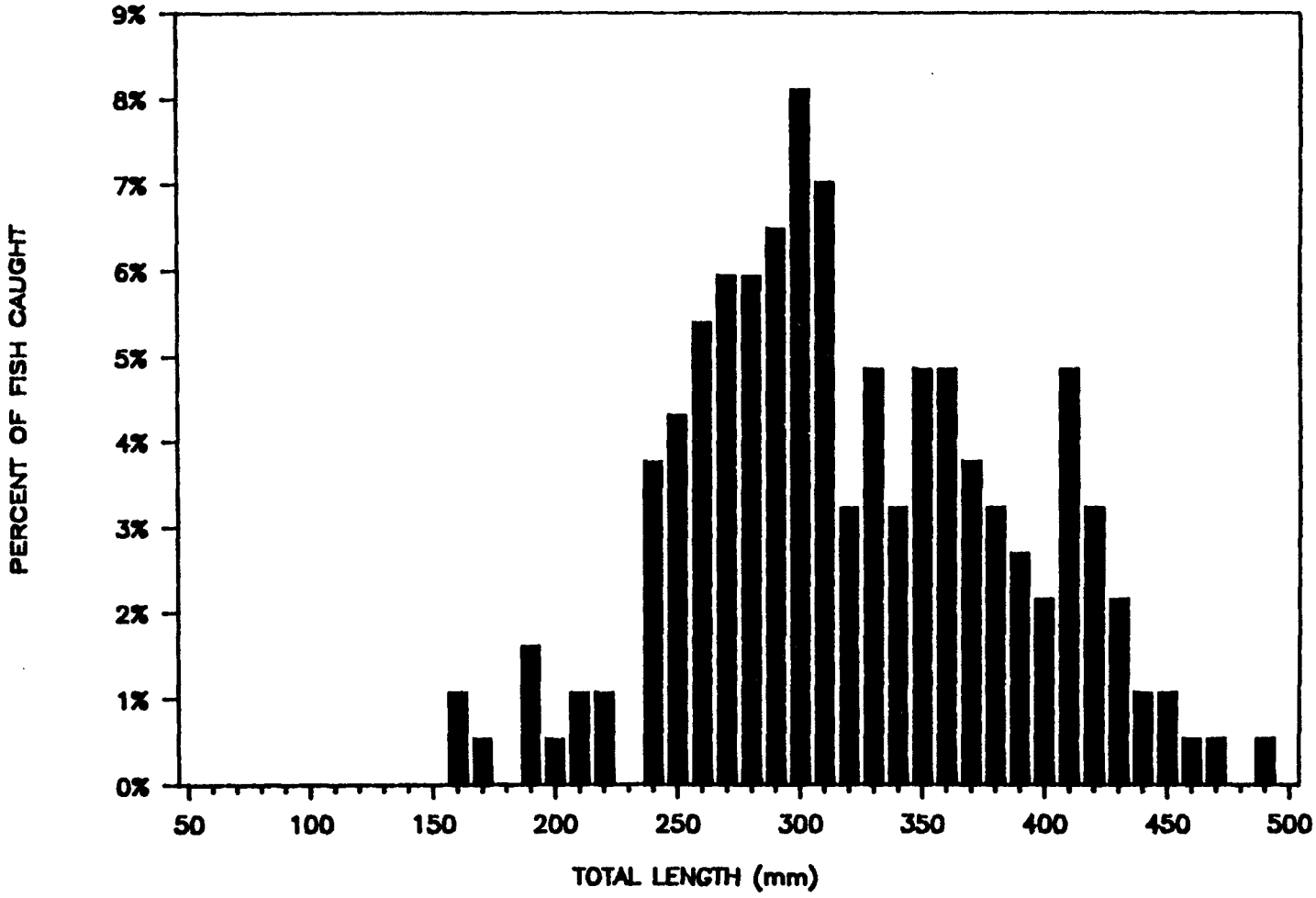

Figure 8. Length frequency of wild rainbow trout harvested by anglers, 1987.

Table 7. Angler residence and methods used on the Big Wood River, 1986 and 1987.

Section	Year	Anglers interviewed N	Percent anglers Res.	Nonres.	Percent using Bait	Lure	Fly	Multiple
1	1987	162	90	10	60	11	19	10
3	1986	124	69	31	54	7	36	3
4	1986	32	75	25	63	13	22	2
	1987	167	80	20	48	9	36	7
5	1987	146	66	34	30	8	58	4
6	1986	59	53	47	47	5	41	7
7	1986	47	40	60	34	6	60	0
	1987	174	53	47	31	5	59	5
8	1986	74	51	49	58	9	33	0
9	1987	56	48	52	29	7	59	5
10	1986	48	56	44	64	9	27	
11	1986	53	32	68	--	2	98	0
	1987	215	35	65	--	1	99	0
12	1986	64	60	40	53	8	33	7
Totals[a]		1,074	67	33	46	8	41	5

[a]Excluding Section 11. Most recent year included.

The Winter Fishery

Anglers fished an estimated 1,593 hours on censused sections of the Big Wood River between January 1 and March 27 (Table 8). Effort averaged 40 hours per km of stream censused. Effort was largest during March.

Catch rates averaged 0.42 fish per hour in general regulation sections and 0.50 fish per hour in the catch-and-release section (11) (Appendix G). Anglers caught an estimated 690 trout (Table 9). Anglers released 50% of the total catch and 38% of the catch within general regulation sections.

Anglers harvested approximately 345 trout, of which 88% were wild rainbow trout (Table 9). The largest harvest of wild rainbow trout occurred in sections 3, 4, 6, and 9. Harvested trout ranged from 280 to 420 mm and averaged 330 mm.

Residents comprised a majority of the anglers we interviewed (Appendix G). Most anglers used bait (53%) or flies (43%) within general regulation sections.

Evaluation of Special Regulations

Fish population data in stream reaches managed under general angling regulations were compared with data from reaches managed under catch-and-release regulations.

Big Wood River

During summer, wild rainbow trout were more abundant in the general regulation reaches than in the catch-and-release reach (Table 10). The density of trout larger than 300 mm was nearly six times that in the catch-and-release reach.

The density of trout declined between the summer and fall in both reaches (Table 10). Within general regulation reaches, the density of trout larger than 300 mm declined by 31% from summer to fall, while the density of large trout in the catch-and-release reach remained similar.

Little Wood River

Densities of brown trout were larger in the catch-and-release reach (#8) as compared to the general regulation reach (#9) during all three seasons surveyed (Table 10). Densities of large brown trout (>300 mm) were 5 to 7 times more abundant in Reach 8 as compared to Reach 9 during spring and summer surveys. Large brown trout apparently migrated into reaches 8 and 9 to spawn in the fall, resulting in similar densities of large (>300 mm) trout.

Table 8. Estimated angler effort (hours) by census interval and section, Big Wood River, January-March, 1988. (95% confidence intervals are in parentheses.)

Interval	Dates		Effort by census section								
			3	4	6	7	8	9	10	11	Total
January	1/1-1/31	Actual	20 (40)	63 (92)	35 (50)	0	0	0	12 (24)	47 (50)	
		Expanded	20	63	49	0	0	0	17	66	215
February	2/1-2/29	Actual	126 (120)	63 (69)	11 (21)	32 (44)	11 (21)	42 (55)	0	126 (106)	
		Expanded	126	63	15	45	15	59	0	176	499
March	3/1-3/27	Actual	Ni (72)	72 (79)	302 (224)	12 (24)	0 – 15	374 (311)	0 – 17	24 (31)	879
Total			241	198	366	57		433		266	1,593

Table 9. Estimated harvest and catch (fish harvested and released) of game fish by anglers on the Big Wood River, January-March, 1988.

	Harvest		Total		
Section	Hatchery rainbow trout	Wild rainbow	Harvest	Release	Catch total
3	8	55	63	39	102
4	6	45	51	32	83.
6	11	84	95	59	154
7	0	15	15	9	24
8	1	3	4	2	6
9	14	99	113	69	182
10	1	3	4	3	7
11	- Catch-and-release - -			132	132
Total	41	304	345	345	690

Table 10. Size and abundance of trout in reaches of the Big and Little Wood rivers managed under catch-and-release (CR) and general angling regulations, 1987.

Season	Regulation	Size				Total trout/ km	Trout/ km >300 mm
		Reach	Mean total length	%>300 mm	2>400 mm		
		Big Wood River - Wild Rainbow Trout					
Summer	CR	6	192	8	2	267	21
	General	2-5	224	19	5	694	132
Fall	CR	6	209	11	2	195	21
	General	3, 4	216	25	2	365	91
		Little Wood River - Brown Trout					
Spring	CR	8	214	13	6	307	40
	General	9	203	8	4	104	8
Summer	CR	8	228	12	3	305	37
	General	9	208	3	0	149	5
Fall	CR	8	258	18	2	254	46
	General	9	245	21	0	202	42

Reach 8 supported larger trout than Reach 9 during all seasons surveyed (Table 10). The mean total length of trout in both reaches increased between spring and fall. Movement of large trout into Reach 9 in the fall also resulted in a similar percentage of trout larger than 300 mm in both reaches.

Trout-Habitat Relationships

Wild rainbow trout were most abundant in pool habitats; including secondary channel, plunge, lateral scour, and backwater type pools (Table 11). Although riffles and glides account for a majority of the total surface area within most stream reaches (Thurow 1987), these habitats support low densities of trout.

The presence of cover components had a pronounced effect on trout abundance. Of 2,224 trout observed in 37 sites, 71% were associated with cover components (Table 12). A larger proportion of the trout observed were associated with mid-channel areas than with no-cover or riprapped bank areas.

Irrigation Diversions

The largest concentrations of trout were found in the Baseline Bypass and District canals. We observed 1,624 rainbow trout in 6.7 km of the Baseline Bypass and 2,596 rainbow trout in 2.0 km of the District Canal (Table 13). Two brook trout were observed in the District Canal, and mountain whitefish (juveniles and adults) were observed in both canals but not enumerated. Snorkeling was an effective method of surveying fish in these canals.

Trout ranged in size from 70 mm to 500 mm. Young-of-the-year trout (<100 mm) were the predominant fish observed in all canals except the Baseline Bypass (Table 13). The Baseline Bypass Canal sustained higher water velocities and fewer pools than the other canals. The size of the canals and amount of cover also influenced the abundance of large trout. Baseline Bypass, District, and the Hiawatha canals supported the largest numbers of trout exceeding 200 mm. These canals sustained the largest flows at the time of sampling: 20 cfs, 38 cfs, and 25 cfs, respectively, based on Water Master records. The canal banks were lined with cottonwood trees and brush which provided an extensive canopy over the water and root masses as instream cover. Several woody debris components were also located in these canals. Within the remaining canals, the largest concentrations of fish were found near the headgates.

Table 11. Density of wild rainbow trout observed in different habitat types by snorkeling, Big Wood River, 1987.

Habitat type	Density (trout per 100 m^2) by reach 2 Density (N)	3 Density (N)	4 Density (N)	Mean trout/100 m^2	Mean trout/100 m	Sample size
Lateral scour pools	18.1 (7)	23.4 (5)	26.3 (5)	22.2	278.7	17
Riffles	4.6 (4)	2.8 (1)	10.5 (2)	5.7	83.8	7
Secondary channel pools	70.1 (1)	- (0)	61.7 (2)	63.0	376.0	3
Glides	21.1 (2)	7.3 (3)	6.3 (2)	9.3	179.1	7
Plunge pools	30.8 (1)	- (0)	- (0)	30.8	197.3	1
Backwater pool	-	10.9 (1)	27.7 (1)	21.5	153.3	2
Totals	15.8 (15)	11.0 (10)	20.0 (12)			37

Table 12. Number and percent of wild rainbow trout observed in snorkeling transects in association with cover, no cover, mid-channel, and riprap areas, 1987.

Category	Trout by reach						Total trout	
	2		3		4			
	No	(2)	No.	(Z)	No.	(2)	No.	(Z)
Cover component	599	(79)	367	(69)	613	(65)	1,579	(71
No cover component	102	(13.5)	38	(8)	83	(9)	223	(10
Mid-channel	50	(7)	124	(23)	169	(18)	343	(15
Riprap	3	(0.5)	--	--	76	(8)	79	(4)
Totals	754		529		941		2,224	

Table 13. Numbers of trout observed in canals surveyed on the Big Wood River, 1987.

Canal	Dates surveyed	Location	Distance (km)	Trout observed by size group					Total trout	Trout per
				<100 mm	100-200 mm	200-300 mm	300-400 mm	>400 mm		
Visual surveys										
Black	8/25	Headgate to Dragonwood Rd.	0.8	200	1	0	0	0	201	251
Cove	8/18	Headgate to Hwy. 75	5.1	50	37	0	0	0	87	17
Glendale	9/10	Headgate to 3rd bridge downstream	1.9	125	100	0	0	0	225	118
Hiawatha	8/17; 8/21	Headgate to Indian Cr.	6.5	111	41	5	4	0	161	25
Kohler	9/10	Headgate to Hwy. 75	2.2	3	2	0	0	0	5	2
Meiser	8/17	Headgate downstream	0.8	---------- Dewatered ----------						0
Osborn	8/18; 8/21	Headgate to Hwy. 75	3.1	70	38	2	0	0	110	35
Totals			20.4	559	219	7	4	0	789	$\bar{x}$=39
Snorkel surveys										
Baseline Bypass	9/15	Headgate to Baseline headgate	5.0	338	443[b]	[b]	95	12	888	178
		Baseline headgate to Brown headgate	1.7	341	322	18	55	0	736	433
District	9/14	Headgate to 1st headgate on Gannet Road	2.0	1,158	453	309	88	12	2,596	1,298

[a]Includes trout not separated by size class.
[b]Includes fish in the 100-300 mm size class.

DISCUSSION

Jobs 1, 2, 3, and 5 of this project will be completed following field work in 1988. Discussion of work associated with those jobs is deferred until the final report. We will do no further work under Job 4 and include a discussion of irrigation impacts in the remainder of this report.

Water is a scarce and valuable resource in the Wood River drainage. Established water rights extend to the 1880s and are protected by state water laws. Unfortunately, the process of diverting water for irrigation has an adverse effect on fish in the Wood River. The problem was recognized in the past (Hauck 1949) and continues today. Diverting water for irrigation impacts fish in four principal ways:

1. Fish enter unscreened diversions and are killed when diversions are dewatered.

2. A 1922 decree authorizes irrigators to divert the entire Big Wood River into a Bypass Canal. Diverting of the water effectively dewaters a 6 km reach of the river below the Glendale diversion, killing all fish present.

3. Diverting the entire river down the Bypass Canal blocks all passage of fish.

4. Use of bulldozers and other large equipment to divert water is destructive to aquatic habitat. Potential solutions to the problems are discussed in the following section.

The initial step in preventing fish losses in unscreened canals is the identification of the canals which sustain the largest numbers of trout. Hauck (1949) surveyed ten canals in 1948 and identified the largest fish populations in the Baseline and District canals. Our surveys in 1987 similarly documented the largest numbers of trout in these two canals. Reaches of these canals support habitat which is suitable to sustain fish and a fishery occurs. As Hauck (1949) observed, water users also salvage trout from their canals. Unfortunately, at the termination of the irrigation season, the canals are dewatered and all unsalvaged fish die. Fish losses may be extensive. In 1987, we observed 4,220 trout in 8.7 km of the Baseline Bypass and District canals (Table 13). An additional 35 km or more of canal were unsurveyed in the District canal complex and 10 km or more went unsurveyed in the Baseline, Dittoe, and Brown Canal complex. If the canals sustained an average of 100 trout per km, an additional 4,500 fish were killed. Additional surveys could help document the magnitude of the fish loss.

Two potential solutions exist to reduce fish losses. One is to prevent fish from entering the canals via a screen or barrier. Although Idaho Code (Section 36-906) requires screening of canals where a need exists, the cost of individual screens often makes such legislation impractical for private landowners or the Department of Fish and Game to fund. A second, more practical solution may exist. Research conducted in the Gallatin River, Montana, suggests that headgate manipulation can be

used to reduce fish losses in unscreened canals (Clothier 1953). The studies found that gradual water removal (staged or ramped reductions) stimulated upstream movement of trout. Trout moved the largest distances where a minimum of cover in the ditch existed; consequently, a project of cover removal in the canals may be beneficial to stimulating fish movements back into the river.

Several irrigation canals operate on the Big Wood River which are suitable for testing the feasibility of staged flow reductions as a means to reduce fish losses. If permission is granted, test and control diversions could be evaluated at the termination of the irrigation season.

The 1922 Baseline Bypass Decree entitles irrigators to divert the entire Big Wood River into a bypass canal at the Glendale Diversion. The Decree is based on the premise that a net water savings of 18 cfs results when the river is diverted out of its natural channel (Upper Big Wood Water Users Association vs. Chapman, August 9, 1922, Decree entered into the District Court of Lincoln County on August 28, 1922 by Judge Ensign, Case No. 37-0892). If the river remains in its natural channel, the 18 cfs supposedly percolates through the streambed and is lost. It would be beneficial to perform a flow analysis to test this premise.

At present, when flows in the Big Wood River at the Glendale Diversion decrease to 150 cfs, a gravel berm is bulldozed across the river channel and all flow is diverted down the Baseline Bypass Canal. Timing of the action varies with stream flow. In 1986, the river was diverted on July 16, while during drought conditions in 1987 and 1988, the river was diverted on April 6 and March 13, respectively. The river channel rapidly dewaters and fish are stranded after the diversion occurs. Periodic salvage operations have been attempted, most recently in 1986 when 563 trout (96% wild rainbow trout) were salvaged from a 0.5 km reach immediately downstream from the berm (Thurow 1987). Numerous pools in downstream areas were dewatered before we were able to salvage the fish. Consequently, the 563 trout salvaged comprise a portion of the actual fish lost.

One solution to the extensive fish losses would be to initiate a staged reduction at the Glendale Diversion. Gradually reducing flows in the river channel would enable trout to migrate out of sections which are being dewatered. The large concentrations of fish near the berm in 1986 suggest that fish migrate rapidly as flows are reduced. However, under the current, immediate flow reduction, many fish are unable to move out of dewatered reaches before they are stranded. Use of a staged reduction would enable some fish to return to the river and it would also concentrate fish near the berm for more efficient salvage.

Obviously, a long-term solution would involve securing of sufficient flow to maintain fish in the river channel. Additional research into existing water law is warranted on this issue.

Historically, trout in lower reaches of the Big Wood River may have migrated substantial distances to spawn in the abundant gravels of the upper watershed. Since 1909 when Magic Reservoir was constructed, upstream passage has been blocked. However, trout in Magic Reservoir and lower reaches of the river continued to migrate upstream to spawning areas.

Hauck (1949) noted the "annual migration of spawning fish" out of Magic Reservoir. Recovery of tagged trout in 1986 (Thurow 1987) and 1987 illustrates that wild rainbow trout continue to migrate upstream from Magic Reservoir and lower reaches of the Big Wood River to spawn in upstream areas.

Operation of the Baseline Bypass Canal effectively blocks any upstream migration of spawning trout. The river channel is dewatered and headgates at the Brown, Bypass, and Dittoe diversions block passage within the Bypass Canal. During relatively normal flow conditions, a breach in the Bypass Canal berm occurs and spawning trout are able to migrate to upstream areas. However, during low flow periods as in 1987 and 1988, the berm is placed from March to May and effectively blocks spawning trout. A salvage operation below the berm on May 12, 1959.documented the presence of ripe, unspawned trout (Gebhards 1959).

Two potential solutions exist. One would require maintaining flow in the river channel and passage at the Glendale Diversion. Another would require a survey of the headgates in the Bypass Canal to determine the feasibility of installing fish passage devices.

Irrigators currently use bulldozers and other equipment to construct gravel dikes for diverting water from the river into canals. This annual disturbance impacts stream hydraulics by: destroying the streambed armoring, increasing channel erosion, and contributing to bedload movement. The disturbance also disrupts spawning and rearing areas for fish and aquatic insect production. In many cases, annual streambed disturbance causes stream mechanics to respond, making the job of diverting water more difficult and costly each year (Anonymous 1987b).

During 1987, the Clark Fork Coalition conducted tests on an alternative irrigation diversion structure (Anonymous 1987b). The purpose was to develop an alternative to the use of streambed gravel for diversion dikes. Criteria for alternative structures included: (1) portable, durable, repairable, and economical; (2) easily installed by two people and a farm tractor; (3) capable of supporting a 1 m head of water; (4) adjustable to water supply and demand; (5) minimized streambed erosion and aggradation; and (6) minimized streambank erosion.

Structures were tested in two locations and both met most of the criteria. The Clark Fork Coalition plans to modify the structures with improvements and retest them in 1988. Final designs may have application to diversions on the Big Wood River.

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Tom McArthur assisted with data analysis and graphics. Bonnie Mulligan typed the draft copy of the report.

LITERATURE CITED

Anonymous. 1987a. Participating Agreement between U.S. Department of Agriculture-Forest Service, U.S. Department of Interior-Bureau of Land Management, Idaho Department of Transportation, Idaho Department of Fish and Game, Blaine County and City of Ketchum. USDA-Forest Service, Sawtooth National Forest, Ketchum Ranger District. Ketchum, Idaho.

Anonymous. 1987b. Alternative irrigation diversion demonstration project. 1987 field trials. Prepared by the Clark Fork Coalition and Bitterroot Trout Unlimited. Missoula, Montana.

Bisson, P.A., J.L. Nielsen, R.A. Palmason, and.E. Grove. 1982. A system of naming habitat types in small streams, with examples of habitat utilization by salmonids during low stream flow. Pages 62-73 in N.B. Armatrout, editor. Acquisition and utilization of aquatic habitat inventory information. American Fisheries Society, Western Division, Bethesda, Maryland.

Clothier, W.D. 1953. Fish loss and movement in irrigation diversions from the West Gallatin River, Montana. Journal of Wildlife Management. 17(2):144-158.

Gebhards, S.V. 1959. Inter-Department memorandum to James Simpson. Idaho Department of Fish and Game. Boise, Idaho.

Hauck, F. 1949. A survey of fish losses in irrigation diversion of Big Wood River in determining the placement of an experimental fish screen. Idaho Department of Fish and Game. Boise, Idaho.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA-Forest Service Intermountain Forest and Range Experimental Station, General Technical Report INT-138, Ogden, Utah.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada 191, Ottawa, Ontario, Canada.

Thorpe, J.R. 1988. Hayspur Hatchery Annual Report. Idaho Department of Fish and Game, Boise.

Thurow, R. 1987. Wood River Fisheries Investigations. Idaho Department of Fish and Game. Job Performance Report. F-73-R-9. Boise, Idaho.

APPENDICES

Appendix A. Data used in calculating population estimates within electrofished reaches of the Big Wood River, 1987.

		Marking		Recapture			
Reach	Season	Date	No. fish marked	Date	No. fish captured	Recaptured fish	Type of estimate
1	Spring	4/21	21	4/28	59	1	Petersen
2	Spring	4/22	53	4/29	51	1	Petersen
	Summer	7/22	145	7/29	138	11	Petersen
	Fall	10/11	163	10/19	88	3	Petersen
3	Spring	4/23	12	4/30	16	0	
	Summer	7/23	102	7/30	105	16	Petersen
	Fall	10/16	114	10/23	82	12	Petersen
4	Spring	4/26	29	5/6	14	0	
	Summer	7/24	119	7/31	147	5	Schnabel
			251	8/4	86	15	
	Fall	10/12	141	10/20	50	17	Petersen
5	Summer	8/2	155	8/7	166	39	Petersen
6	Spring	5/5	35				
	Summer	8/1	187	8/6	212	47	Petersen
	Fall	10/15	156	10/22	110	40	Petersen
7	Summer	8/21	53	8/27	35	16	Petersen

Appendix B. Estimated angler effort (hours) by census interval and section, Big Wood River, 1987 (95% confidence intervals in parentheses).

Interval	Beginning	Census section (km) 1 (10.5 km)	2 (5.7 km)	4 (3.2 km)	5 (4.6 km)	7 (2.1 km)	9 (2.4 km)	11 (8.3 km)	Pooled estimate (by interval)
A	May 23	909 (551)	20 (40)	263 (173)	348 (237)	278 (141)	129	66 (94)	1,992 (817)
B	Jun 6	196 (141)	0	108 (158)	36 (55)	26	26	26 (51)	417 (340)
1	Jun 13	860 (474)	129 (202)	278 (214)	464 (554)	191 (174)	108 (80)	108 (160)	2,137 (1,379)
2	Jun 27	549 (353)	0[b]	414 (293)	649 (317)	675 (341)	94 (60)	953 (517)	3,334 (1,031)
3	Jul 11	660 (512)	0	610 (556)	580 (487)	490 (214)	150	800 (270)	3,270 (1,136)
4	Jul 25	688 (264)	0	387 (235)	552 (273)	424 (227)	133 (106)	608 (237)	2,606 (702)
5	Aug 8	297 (252)	0	548 (344)	762 (374)	594 (308)	511	905 (399)	3,571 (1,596)
6	Aug 22	257 (165)	0	403 (168)	296 (193)	434 (281)	35	885 (682)	2,291 (1,022)
7	Sep 5	140 (92)	0	423 (408)	499 (399)	543 (160)	63 (32)	461 (301)	2,129 (899)
8	Sep 19	19 (103)	0	190 (138)	340 (348)	261 (205)	44 (51)	356 {220)	1,266 (770)
9	Oct 3	37 (59)	0	90 (129)	418 (404)	127 (30)	75	269 (303)	1,001 (795)
10	Oct 17[a]	37	0	90	418	127 (30)	75	269	1,001 (795)
11	Oct 31	33 (67)	0	0	80 (136)	13	0	13 {27)	140 (125)
Total	May 23-Nov 13	4,754	149	3,804	5,442	4,183	1,443	5,719	Grand total
Pooled estimate (by section)		4,616 (1,175)	143 (203)	3,943 (1,026)	5,446 (1,214)	4,255 (831)	1,469 (513)	5,881 (1,484)	25,753
Estimated hours per km		440	25	1,232	1,184	2,036	612	709	

[a]No counts completed; effort estimated to be similar to previous interval. In 1986, effort during Interval 10 was ≥ Interval 9 in six of seven sections.
[b]Section 2 was dewatered during Interval 1.

Appendix C. Total effort estimates, Big Wood River, 1987.

Creel census section (km)												
1 (10.5) km	2 (5.7 km)	3 (9.2 km)	4 (3.2 km)	5 (4.6 km)	6 (6.8 km)	7 (2.1 km)	8 (4.6 km)	9 (2.4 km)	10 (3.7 km)	11 (8.3 km)	12 (13.2 km)	Total (74.3 km)
1986 estimated effort (h)												
-	-	4,222	1,954	-	3,919	2,769	4,205	-	3,484	3,635	5,035	
1987 estimated effort (h) and 1986 estimates expanded by 68%												
4,616	143	7,093	3,943	5,446	6,584	4,255	7,064	1,469	5,853	5,881	8,459	
1987 effort per km (h)												
440	25	771	1,232	1,184	968	2,026	1,536	612	1,582	708	641	

Total effort (h) 1987 and 1986 expanded estimates = 60,806
818 h/km.

Appendix D. Creel census statistics collected on the Big Wood River, May to November, 1987.

Section	Interval	Anglers interviewed	Hours fished	Total fish			Catch rate (fish/hour)			Harvest by species			
				Harvest	Release	>300 mm	Harvest	Release	Total	Hatchery rainbow	Wild rainbow	Brook trout	Brown trout
1	A	30	67.00	59	22	0	0.88	0.33	1.21	6	30	3	4
	B	27	25.25	6	14	0	0.24	0.55	0.79	1	5	0	0
	1	24	31.75	2	19	0	0.06	0.60	0.66	0	0	0	2
	2	22	52.75	22	31	2	0.42	0.59	1.01	2	14	1	5
	3	13	20.50	5	6	0	0.24	0.29	0.53	1	1	0	3
	4	8	18.75	2	13	2	0.11	0.69	0.80	0	2	0	0
	5	7	15.25	8	0	0	0.52	0	0.52	0	4	0	4
	6	18	33.25	16	42	0	0.48	1.26	1.74	3	4	0	8
	7	7	9.50	0	14	0	0	1.47	1.47	0	0	0	0
	8	3	0.75	0	0	0	0	0	0	0	0	0	0
	9	3	3.00	0	0	0	0	0	0	0	0	0	0
Total		162	277.75	120	161	4	0.43	0.58	1.01	13	60	4	26
4	A	10	10.75	0	8	0	0	0.74	0.74	0	0	0	0
	B	4	1.50	0	0	0	0	0	0	0	0	0	0
	1	30	27.25	3	19	1	0.11	0.70	0.81	0	1	1	0
	2	51	77.00	55	37	6	0.71	0.48	1.19	12	27	0	0
	3	13	16.25	13	17	1	0.80	1.05	1.85	2	10	1	0
	4	8	9.75	9	6	0	0.92	0.62	1.54	3	6	0	0
	5	20	27.75	7	26	7	0.25	0.94	1.19	5	2	0	0
	7	17	19.00	9	25	6	0.47	1.32	1.79	1	8	0	0
	8	9	11.25	1	3	0	0.09	0.27	0.36	1	0	0	0
	9	5	1.75	0	0	0	0	0		0	0	0	0
Total		167	202.25	97.	141	21	0.48	0.70	1.18	24	54	2	

Appendix D, continued.

Section	Interval	Anglers interviewed	Hours fished	Total fish			Catch rate (fish/hour)			Harvest by species			
				Harvest	Release	Total >300 mm	Harvest	Release	Total	Hatchery rainbow	Wild rainbow	Brook trout	Brown trout
5	A	2	3.00	0	0	0	0	0	0	0	0	0	0
	B	2	0.50	0	0	0	0	0	0	0	0	0	0
	1	16	26.00	6	22	3	0.23	0.85	1.08	3	3	0	0
	2	44	48.75	11	41	6	0.23	0.84	1.07	1	10	0	0
	3	14	18.25	10	23	2	0.55	1.26	1.81	5	5	0	0
	4	6	2.25	1	2	1	0.44	0.89	1.33	0	1	0	0
	5	16	17.50	11	7	2	0.63	0.40	1.03	2	9	0	0
	6	4	2.50	0	0	0	0	0	0	0	0	0	0
	7	26	39.75	14	38	7	0.35	0.96	1.31	1	10	1	0
	8	4	8.75	1	20	2	0.11	2.29	2.40	0	1	0	0
	9	11	6.50	2	1	1	0.31	0.15	0.46	0	2	0	0
	11	1	0.25	1	0	0	4.00	0	0	0	1	0	0
Total		146	174.00	57	154	24	0.33	0.89	1.22	12	42	1	0
7	A	8	6.95	1	0	0	0.14	0	0.14	0	1	0	0
	B	5	8.50	1	1	0	0.12	0.12	0.24	0	1	0	0
	1	21	19.16	6	24	10	0.31	1.25	1.56	3	2	0	0
	2	71	98.25	18	147	48	0.18	1.50	1.68	0	18	0	0
	3	11	16.25	2	5	1	0.12	0.31	0.43	1	1	0	0
	4	18	35.75	11.	26	7	0.31	0.73	1.04	1	7	0	0
	5	20	31.00	5	17	6	0.16	0.55	0,71	1	3	0	0
	6	1	4.50	2	10	0	0.44	2.22	2.66	0	2	0	0
	7	11	33.50	13	13	1	0.39	0.39	0.78	0	13	0	0
	8	5	5.50	1	6	0	0.18	1.09	1.27	1	0	0	0
	9	2	1.25	0	0	0	0	0	0	0	0	0	0
	11	1	0.25	0	0	0	0	0	0	0	0		0
Total		174	260.86	60	249	73	0.23	0.95	1.18	7	48	0	0

Appendix D, continued.

Section	Interval	Anglers interviewed	Hours fished	Total fish: Harvest	Total fish: Release	Total fish: Total >300 mm	Catch rate (fish/hour): Harvest	Catch rate (fish/hour): Release	Catch rate (fish/hour): Total	Harvest by species: Hatchery rainbow	Harvest by species: Wild rainbow	Harvest by species: Brook trout	Harvest by species: Brown trout
9	A	1	1.00	2	0	0	2.00	0.00	2.00	1	1	0	0
	1	10	8.00	3	5	2	0.38	0.63	1.01	3	0	0	0
	2	28	39.50	16	75	16	0.41	1.90	1.50	9	6	1	0
	3	4	6.75	0	4	2	0	0.59	0.59	0	0	0	0
	4	4	3.50	1	1	0	0.29	0.29	0.58	0	1	0	0
	5	6	2.50	1	4	1	0.40	1.60	2.00	1	0	0	0
	8	3	1.50	0	4	0	0.00	2.67	2.67	0	0	0	0
Total		56	62.75	23	93	21	0.37	1.48	1.85	14	8	1	0
11	1	7	10.76	0	70	15	0	6.51	6.51	-	-	-	-
	2	71	86.25	0	224	53	0	2.60	2.60	-	-	-	-
	3	19	26.00	0	44	6	0	1.69	1.69	-	-	-	-
	4	21	31.00	0	51	10	0	1.65	1.65	-	-	-	-
	5	32	46.75	0	85	27	0	1.82	1.82	-	-	-	-
	6	27	63.75	0	33	13	0	0.52	0.52	-	-	-	-
	7	11	14.50	0	17	3	0	1.17	1.17	-	-	-	-
	8	20	44.50		68	4	0	1.53	1.53	-	-	-	-
	9	6	12.25		6	2	0	0.49	0.49	-	-	-	-
	11	1	0.50	0	0	0	0	0	0				
Total		215	336.25	0	598	133	0	1.78	1.78				

Appendix E. Total estimated harvest and catch of trout by anglers on the Big Wood River, 1986 and 1987.

Section	Year censused	Harvest: Hatchery rainbow trout	Harvest: Brook trout	Harvest: Wild rainbow trout	Harvest: Total harvest l	Harvest: Total harvest I/km	Catch[a]: Total catch 1	Catch[a]: Total catch 1/km	Released
1	1987	258	80	1,151	1,985[b]	189	4,662	444	57
3	1986	1,030	17	642	1,689	183	3,800	413	56
4	1986	671	0	853	1,524	476	2,813	879	46
	1987	568	38	1,287	1,893	591	2,873	1,454	59
5	1987	395	36	1,366	1,797	297	3,889	1,433	73
6	1986	565	0	611	1,176	173	5,172	761	77
7	1986	235	0	706	941	448	4,348	2,070	78
	1987	127	0	852	979	466	5,022	2,391	81
8	1986	1,443	0	407	1,850	402	4,289	932	57
9	1987	332	22	190	544	227	2,718	1,132	80
10	1986	1,789	0	476	2,265	612	4,390	1,186	48
11	1986	----------Catch-and-release----------					7,088	854	100
	1987						10,468	1,261	100
12	1986	2,366	0	555	2,921	221	3,726	'282	23
Total[s]		8,873	193	7,537	17,099		51,009	744	66
Percent of total		52	1	44					

[a]Includes number harvested + number released.
[b]Includes 496 brown trout, 3% of total.
[c]Most recent year included.

Appendix F. Angler opinion survey results, Big Wood River, 1987.

Specific questions posed to anglers and their responses (as percentages):

1) How many days per year do you fish the Big Wood River?

Response by section	<5	5-10	>10	N
1	74	17	9	23
4	24	27	49	33
5	31	24	45	42
7	30	17	53	30
9	43	0	57	7
Total	37	21	42	135
11	39	35	26	69
Response by method	**<5**	**5-10**	**>10**	**N**
Bait	30	18	52	50
Lure	20	20	60	5
Fly	33	26	41	76
Multiple	100	0	0	10
Fly (Section 11)	40	34	26	68

2) How would you rate your fishing trip?

Response by section	Excellent	Good	Fair	Poor	N
1	4	52	18	26	23
4	24	61	15	0	33
5	23	75	2	0	43
7	20	47	30	3	30
9	20	80	0	0	5
Total	20	61	14	5	135
11	32	43	24	1	68
Response by method					
Bait	16	61	18	5	44
Care	20	60	20	0	5
Fly	24	63	12	1	75
Multiple	0	50	10	40	10
Fly (Section 11)	33	43	24	0	67

3) Is more public access for fishing needed on the Big Wood River?

Response by section	Yes	No	N
1	35	65	23
4	28	72	32
5	28	72	40
7	47	53	30
9	17	83	6
Total	33	67	131
11	31	69	67

Response by method	Yes	No	N
Bait	45	55	44
Lure	0	100	4
Fly	28	72	74
Multiple	22	78	9
Fly (Section 11)	32	68	66

4) Are you satisfied with the current size and abundance of trout?

Response by section	Yes	No	N
1	52	48	23
4	75	25	32
5	76	24	42
7	75	25	28
9	100	0	5
Total	72	28	130
11	68	32	65

Response by method			
Bait	70	30	43
Lure	80	20	5
Fly	77	23	73
Multiple	44	56	9
Fly (Section 11)	68	32	65

Appendix F, continued.

5) Would you support more restrictive regulations on sections of the Big Wood River if these regulations increased the size and abundance of trout?

Response by section	Yes	No	N
1	86	14	22
4	88	12	33
5	90	10	42
7	86	14	29
9	100	0	7
Total	89	11	133
11	97	3	67
Response by method			
Bait	88	12	43
Lure	100	0	5
Fly	93	7	75
Multiple	50	50	10
Fly (Section 11)	98	2	66

6) Do you support the stocking of hatchery rainbow trout to maintain harvest opportunity in some sections of the Big Wood River?

Response by section	Yes	No	N
1	91	9	22
4	88	12	32
5	88	12	41
7	86	14	29
9	100	0	7
Total	89	11	131
11	92	8	66
Response by method			
Bait	95	5	44
Lure	100	0	5
Fly	82	18	72
Multiple	100	0	10
Fly (Section 11)	92	8	65

7) Stream alterations (channelization, floodplain development, snag removal, riprap) have adversely affected fish populations in the Big Wood River by decreasing the amount of habitat.

Do you favor measures to prevent further floodplain development and stream alterations?

Response by section	Yes	No	N
1	73	27	22
4	91	9	33
5	95	5	42
7	93	7	28
9	67	33	6
Total	89	11	131
11	93	7	67
Response by method			
Bait	89	11	44
Lure	80	20	5
Fly	92	8	73
Multiple	67	33	9
Fly (Section 11)	92	8	66

8) Do you support the current winter fishery which allows harvest of trout?

Response by section	Yes	No	N
1	53	47	19
4	87	13	31
5	69	31	32
7	79	21	28
9	50	50	6
Total	72	28	116
11	62	38	61
Response by method			
Bait	83	17	35
Lure	80	20	5
Fly	70	30	67
Multiple	44	56	9
Fly (Section 11)	63	37	60

9) Section 1 only. In recent years, brown trout have been increasing in lower sections of the Big Wood River. What is your opinion of this increase?

Response	Support	Oppose	No opinion	N
Section 1	75	10	15	20
Response				
Bait	55	18	27	11
Lure	100	0	0	1
Fly	100	0	0	3
Multiple	100	0	0	5

Appendix G. Creel census statistics collected on the Big Wood River, January–March 1988.

Section	Anglers		Hours	Method			Harvest[a]		Total trout			Catch rate (fish/hr)		
										Released				
	Resident	Nonresident	fished	Bait	Lure	Fly	Hatchery rainbow	Wild rainbow	Harvest	Total	>300 mm	Harvest	Release	Total
3	14	0	16.05	13	0	1	1	3	4	3	2	0.25	0.19	0.44
4	7	0	4.20	3	2	2	0	0	0	0	0	0.00	0.00	0.00
5	15	0	26.00	5	0	10	0	4	5	1	0	0.19	0.04	0.23
6	2	1	4.25	2	0	1	0	0	0	4	2	0.00	0.94	0.94
7	4	0	3.50	3	0	1	0	4	4	0	0	1.14	0.00	1.14
8	1	0	0.50	0	0	1	0	0	0	0	0	0.00	0.00	0.00
9	6	2	15.75	2	0	6	1	4	5	3	0	0.32	0.19	0.51
10	1	0	0.30	0	0	1	0	0	0	0	0	0.00	0.00	0.00
11	6	2	10.10	0	0	8	0	0	0	5	1	0.00	0.50	0.50
Total	56	5	80.65	28	2	31	2	15	18	16	5	0.22	0.20	0.42
Total (excluding Section 11	50	3	70.55	28	2	23	2	15	18	11	4	0.26	0.16	0.42

[a]Anglers also harvested 22 mountain whitefish, 19 in Section 9.

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